HEIGHT AND POSITION OF MOUNT ST. ELIAS

BY

ISRAEL C. RUSSELL

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ISRAEL C. RUSSELL,

United States Geological Survey,

Washington, D. C.

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The height and position of Mount St. Elias have been measured several times during the past century with varying results. The measurements made prior to 1891 have been summarized and discussed by W. H. Dall, of the U. S. Coast and Geodetic Survey.* The various results obtained are shown in the following table. With the exception of the position determined by Malaspina and the measurements of 1891, they are copied from Dall's report.

Height and Position of Mount St. Elias.

Date.	Authority.	Height.	Latitude.	Longitude.
1786	La Pérouse	12,672 feet.	60° 15′ 00″	140° 10′ 00″
1791	Malaspina	17,851 "	60 17 35	140 52 17
1794	Vancouver		60 22 30	140 39 00
1847	Russian Hydrographic Chart, 1378	17,850 "	60 21 00	141 00 00
1847	Tebenkof (Notes)	16,938 "	60 22 36	140 54 00
1849	Tebenkof (Chart VII)	16,938 "	60 21 30	140 54 00
	Bach. Can. Inseln.	16,758 "	60 17 30	140 51 00
1872	English Admiralty Chart 2172	14,970 "	60 21 00	141 00 00
1874	U.S. Coast Survey	19,500 ± 400 "	60 20 45	141 00 12
1891	Nat. Geog. Soc. Ex.	18,100 ± 100 "	60 17 51	140 55 30

The position given by Malaspina is from a report on astronomical observations made during his voyage,† which places the mountain in longitude 134° 33′ 10″ west of Cadiz. Taking

*Rep. of the Superintendent of the U. S. Coast Survey for 1875, pp. 157–188.

† Memorias sobre las observaciones astronomicas hechas por los navegantes Españoles en distintos lugares del globe; Por Don Josef Espinosa y Tello. Madrid, en la Imprente real, Ano de 1809: 2 vols., large 8°; vol. 1, pp. 57–60. My attention was directed to this work by Dr. Dall, who owns the only copy I have seen.

the longitude of Cadiz as 6° 19′ 07″ west of Greenwich, the figures given in the table are obtained.

The data from which the various determinations made previous to 1874 were obtained have not been published. The observations made by Messrs. Dall and Baker, of the U. S. Coast and Geodetic Survey, are published in full in the annual report of that Survey for 1875, already referred to. The observations made by myself last summer as a part of the work of an expedition sent to Mount St. Elias by the National Geographic Society and the U. S. Geological Survey, from which the height and position of the mountain have been computed, are as follows:

A base line 16,876 feet long was measured on the beach at Icy bay. The line, with the exception of section *C* to *D*, as shown below, was measured three times in sections of about 3,000 feet each. The distances given below in columns 1 and 2 were obtained with a 100-foot steel tape, and those given in column 3 with a 300-foot iron wire. These are rough measurements, made without the use of a plumb-bob and without taking account of temperature. The ground was quite smooth, with a rise of about five feet in the center; but section *C* to *D* was crossed by a stream channel about 300 feet broad and twenty feet deep. Throughout much of the distance the ground was covered with grass, which was only partially cleared away. The stations at the ends of the line were ten feet above high tide. The bearing of the line from the western base was S. 89° E., magnetic.

Measurements of Base Line.

	1.		2.		3.		Mean.	
	Ft.	*in.*	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*
Western base to station *A*	3,179	10	3,178	7	3,178	9	3,179	1
Station *A* to station *B*	2,355	2	2,354	1	2,354	2	2,354	6
Station *B* to station *C*	3,589	0	3,587	9	3,586	0	3,587	7
Station *C* to station *D*	Rejected.		2,609	2	2,609	5	2,609	3
Station *D* to eastern base	5,145	5	5,144	10	Not measured.		5,145	1
Length of base line							16,875	6

The measurements of angles were made with a gradienter reading by vernier to minutes. The error of the vertical arc was —3′, and remained constant during the observations.

Measurements of Angles at Western Base.

		Right vernier.		Left vernier.		Vertical angle.		Date.		
1.	St. Elias.	218°	35′	38°	35′	+ 5°	40′	1891, Aug.	11,	10 a. m.
	Eastern base...	317	6	137	7	.....		"	"	"
2.	St. Elias.....	218	34	38	37	+ 5	40	"	"	"
	Eastern base...	317	6	137	7	.....		"	"	"
3.	St. Elias.....	218	37	38	39	+ 5	40	"	"	"
	Eastern base...	317	6	137	8	.....		"	"	"
4.	St. Elias.....	261	41	81	43	+ 5	40	"	"	"
	Eastern base...	0	10	180	11	.....		"	"	"
5.	St. Elias.....	261	41	81	43	+ 5	40	"	"	"
	Eastern base...	0	10	180	10	.....		"	"	"
6.	St. Elias.....	50	15	230	15	+ 5	40	"	"	6 p. m.
	Eastern base...	148	45	328	45	.....		"	"	"
7.	St. Elias.....	50	15	.....		.....		"	"	"
	Eastern base...	148	45	.....		.....		"	"	"
8.	St. Elias.....	181	5	1	5	+ 5	40	"	"	"
	Eastern base...	279	30	99	32	.....		"	"	"

Measurements of Angles at Eastern Base.

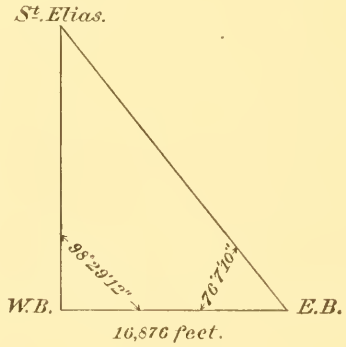
		Right vernier.		Left vernier.		Vertical angle.		Date.		
1.	St. Elias.....	252°	26′	72°	27′	+ 5°	34′	1891, Aug.	17,	11.30 a. m.
	Western base..	176	19	356	19	.....		"	"	"
2.	St. Elias.....	252	26	72	26	+ 5	34	"	"	"
	Western base..	176	19	356	19	.....		"	"	"
3.	St. Elias.....	252	25	72	26	+ 5	34	"	"	"
	Western base..	176	19	356	19	.....		"	"	"
4.	St. Elias.....	252	26	72	27	+ 5	34	"	"	"
	Western base..	176	19	356	19	.....		"	"	"
5.	St. Elias.....	252	26	72	26	+ 5	34	"	"	"
	Western base..	176	19	.....		.....		"	"	"
6.	St. Elias.....	252	27	72	28	+ 5	34	"	"	2 p. m.
	Western base..	176	20	356	20	.....		"	"	"
7.	St. Elias.....	252	28	.....		.....		"	"	4.30 p. m.
	Western base..	176	21	.....		.....		"	"	"

From these observations the following angles between the base line and the line of sight to the summit of Mount St. Elias are obtained. The correction for error of vertical circle has been applied to the angles of elevation.

Resulting Angles.

	Western Base.				Eastern Base.		
	Right vernier.	Left vernier.	Corrected vertical angle.		Right vernier.	Left vernier.	Corrected vertical angle.
1	98° 31′	98° 32′	+5° 43′	1	76° 7′	76° 8′	+5° 37′
2	98 32	98 30	+5 43	2	76 7	76 7	+5 37
3	98 29	98 29	+5 43	3	76 6	76 7	+5 37
4	98 29	98 28	+5 43	4	76 7	76 8	+5 37
5	98 29	98 27	+5 43	5	76 7	.....	+5 37
6	98 30	98 30	+5 43	6	76 7	76 8	+5 37
7	98 30	.....	+5 43	7	76 7		
8	98 25	98 27	+5 43				
	98 29 22	98 29 00			76 6 51	76 7 36	
Mean	98° 29′ 12″		+5° 43′		76° 7′ 10″		+5° 37′

The known elements of the triangle from which the distance of St. Elias from the ends of the base line may be determined are:



These data were sent from the field to the Secretary of the National Geographic Society, and, in connection with other measurements made at the same time, have been computed by

Mr. S. S. Gannett, of the United States Geological Survey. The results of the computation, so far as they relate to Mount St. Elias, are given below:

Computation of the Height of Mount St. Elias.

Station.	*Angle.*	16,876 *ft. log.*	
		Dist. E. base — W. base	4.227270
St. Elias	5° 23′ 38″	A. C. log. sine	1.026862
Western base	98 29 12	log. sine	9.995218
Eastern base	76 07 10	log. sine	9.987129
		St. Elias — W. base	5.241261
		St. Elias — E. base	5.249350

		log. feet.	*log. miles.*	*miles.*
Log. distance; St. Elias — W. base		5.241261	1.518627	33.01
Log. tan angle of elevation 5° 43′		9.000465		
	1.7447 ft.	4.241726		
Curvature and refraction	+ 623			
Western base above sea	+ 10			
St. Elias above sea	18080 ft.			

Correction for curvature and refraction in feet = ⅔ sq. of dist. in miles.

log. distance miles	1.51863
	1.51863
log. 4 =	0.60206
A. C. log. 7 =	9.15490
log. 623 ft. =	2.79422

		log. feet.	*log. miles.*	*miles.*
Log. distance; St. Elias — E. base		5.249350	1.526716	33.63
Log. tan 5° 37′		8.992750	1.526716	
			0.602060	
	17462 =	4.242100	9.154902	
Curvature and refraction	+ 646			
E. base above sea	+ 10	log. 646 ft. =	2.810394	
St. Elias above sea	18118 ft.			

Mean elevation above sea level = 18099 ft.; or in round numbers 18,100 ft.

Mr. A. Lindenkohl, of the U. S. Coast and Geodetic Survey, and Mr. S. S. Gannett have each computed the geographic position of Mount St. Elias, using the azimuth and angle of elevation of the mountain obtained by the U. S. Coast Survey at Port Mulgrave in 1874,* and the elevation given above. From

*Report of the Superintendent of the U. S. Coast Survey for 1875. Appendix 10, pp. 157–188.

these data the approximate position of Mount St. Elias was found to be:

Lat., 60° 17′ 51″ N.
Long., 140° 55′ 30″ W.

The computation by which these results were obtained is given below:

Computation of Geographic Position of Mount St. Elias.

Azimuth: Port Mulgrave to Mount St. Elias =	142° 17′ 17″
Diff. azimuth	— 59 55
+ 180°	+ 180°
Azimuth: Mount St. Elias to Port Mulgrave =	321° 17′ 22″

Latitude.		*Longitude.*	
59° 33′ 42″	= Port Mulgrave	139° 46′ 16″	
+ 44 09	= Diff. lat.	+ 1 09 14	= Diff. long.
60° 17′ 51″	= Mount St. Elias	140° 55′ 30″	

	1st Term. *Log. meters.*	2d Term.
Log. K = (Distance, Mulgrave–St. Elias) =	5.0183184	K^2 = 0.0366
Log. cosine azimuth, Z, 142° 17′ 17″ =	9.8982292	$\sin^2 Z$ = 9.5731
Log. B =	8.5093902	Log. C = 1.6335
Log. 2666″.5 =	3.4259378	Log. 17″.6 = 1.2432
1st term = + 2666″.5		
2d term = — 17 .6		
Difference lat. = 2648″.9		

Log. K	5.0183184
Log. sine azimuth	9.7865328
Log. A*	8.5086148
Arithmetical complement 60° 17′ 51″ =	0.3049593
Log. diff. in longitude 4153″.6 =	3.6184253

Log. diff. long. =	3.61843
Log. sine mean latitude 59° 55′ 46″ =	9.93722
Log. diff. azimuth — 3595″ =	3.55565

*A, *B* and *C* are terms depending on the size and figure of the earth and the latitude of the place.

The geographic position of Mount St. Elias is of popular interest in connection with the boundaries of Alaska.

In the convention between Great Britain and Russia,* wherein the boundaries of Alaska are supposed to be defined, it is stated that the boundary, beginning at the south, after leaving Portland channel, shall follow the summit of the mountains situated parallel to the coast as far as the 141st meridian, and from there northward the said meridian shall be the boundary to the Arctic ocean. Whenever the summit of the mountains between Portland channel and the 141st meridian "shall prove to be at the distance of more than ten marine leagues from the ocean, the limit between the British possessions and the line of coast which is to belong to Russia, above mentioned, shall be formed by a line parallel to the windings of the coast and which shall never exceed the distance of ten marine leagues therefrom."

As Mount St. Elias is approximately in longitude 140° 55′ 30″ west from Greenwich, as already shown, it is therefore only 4′ and 30″ of longitude or 2½ statute miles east of the boundary of the main portion of Alaska. Its distance from the nearest point on the coast is 33 statute miles. There is no coast range in southeastern Alaska parallel with the coast within the limits specified by the treaty, and the boundary must therefore be considered as a line parallel with the coast and ten marine leagues, or 34½ statute miles, inland. The mountain is thus one and one-half miles south of the boundary and within the territory of the United States. Its position is so near the junction of the boundary separating southeastern Alaska from the Northwest Territory with the 141st meridian that it is practically a corner monument of our national domain.

* Message from the President of the United States, transmitting Report on the boundary line between Alaska and British Columbia. 50th Congress, 2d session, Ex. Doc. No. 146, Senate, 1889.